Australian Government
Great Barrier Reef Marine Park Authority

POSITION STATEMENT
Water quality

Our position

Poor water quality is a major threat to the Great Barrier Reef, particularly inshore areas. Improving the quality of water entering the Marine Park is critical and urgent. The Great Barrier Reef Marine Park Authority supports actions that reduce pollutant loads from all land-based sources.

Position snapshot

Good water quality is critical for maintaining the Great Barrier Reef as one of the most beautiful, diverse and complex ecosystems in the world. Since European settlement, Reef water quality has declined due to coastal development and agricultural activities in adjacent catchments.[1] This decline in water quality is a major contributor to the current poor state of many inshore marine ecosystems.[2,3]

The main water quality pollutants that pose a threat to the Reef are primarily from agricultural activities in the catchment and include:

- Fine sediment
- Excess nutrients
- Pesticides (herbicides, insecticides and fungicides) and other pollutants.[4,5]

Contributions from other land-based developments such as urban and industrial areas, mines and ports are comparatively minor, but may be important at some locations.[6,7]

Fine sediment in the water reduces the amount of light available to marine ecosystems, including seagrass meadows and inshore coral reefs, which can affect their growth and reproduction.[2,8,9,10] Excess nutrients are linked to blooms of harmful algae and may exacerbate outbreaks of coral-eating crown-of-thorns starfish, as well as increasing the susceptibility of corals to bleaching and disease.[2,11,12,13] Pesticides, designed to kill crop pests such as weeds and insects, may also affect marine plants and animals, reducing the resilience of nearshore marine habitats.[2,14] The impacts of other pollutants in run-off such as heavy metals, pharmaceuticals and certain personal care products are uncertain and need further assessment.[4,15] Ecosystem declines due to poor water quality can also lead to a decline in Reef-dependent industries and people's well-being and enjoyment of the Reef.[3]

Ongoing exposure to pollutants contributes to the effects of cumulative impacts on the health and resilience of the Reef. Good water quality supports ecosystem resilience and recovery from disturbances.[16,17] This is particularly important under future climate change scenarios, where the frequency of destructive marine heatwaves and the intensity of rainfall events and cyclones is predicted to increase.[3,18]

The joint Australian and Queensland government Reef 2050 Long-Term Sustainability Plan[19] (Reef 2050 Plan) aims to preserve the outstanding universal value of the Reef for current and future generations. Nested under the Reef 2050 Plan is the Reef 2050 Water Quality Improvement Plan 2017–2022[20], which identifies catchment-level pollutant targets to guide collective effort to improve the quality of water flowing to the Reef from land-based sources.

The Authority acknowledges efforts to improve land management practices by landholders and the community in partnership with governments, natural resource managers, industry, research and conservation groups. There has been some progress towards water quality targets, but there is still more to do.[21,22,23] The Authority's Outlook Report 2019 concluded inshore water quality is improving on a regional scale, but too slowly. Greater efforts to improve water quality are needed.[6,24,25]

The Authority supports:

- actions to improve land management practices to better meet water quality targets
- ongoing, targeted investment and monitoring that considers social, cultural and economic outcomes
- the protection and restoration of key coastal ecosystems critical to Reef health
- strengthened partnerships and collaboration to reduce cumulative impacts on the Reef
- education and stewardship activities that ensure adequate stakeholder communication and engagement for improved water quality outcomes.

The Authority takes an adaptive, resilience-based approach to managing the Marine Park. The Authority is committed to actions that support Reef resilience and work in partnership with key stakeholders to implement the Reef 2050 Water Quality Improvement Plan 2017–22.

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Issue: poor water quality is a major threat to the Reef and Reef-dependent users

Most coral reefs grow best in waters that have naturally low concentrations of nutrients and sediments.[2] Maintaining good water quality is critical for supporting the complexity and diversity of the Reef and its interconnected freshwater, estuarine and marine ecosystems.

There are 35 major catchments adjacent to the Great Barrier Reef Region covering 424,000 square kilometres. Changes in land-use since European settlement have resulted in increased loads of pollutants entering the Reef.[6] Modelling indicates loads of fine sediment have increased about five-fold and loads of nutrients (nitrogen) have more than doubled.[6,27]

The inshore area closest to the coast is most exposed to river run-off and pollution from the adjacent catchment.[4,28,29] Inshore reefs and seagrass meadows support significant ecological communities and are used by Traditional Owners, recreational users, tourism operators and some commercial fishers.[3] Declines in Reef habitats or species have potential implications for adjacent coastal communities and Reef-dependent industries. Poor water quality can also affect people's well-being and enjoyment through degraded aesthetics.[3]

Agricultural activities in adjacent catchments are the main source of land-based pollutants at a regional and Reef-wide scale.[1,6] Approximately 72 per cent of the Reef catchment has been modified to support agriculture.[3,30]

Grazing lands are the major contributor of fine sediment and particulate nitrogen, which may be resuspended and transported further into the Reef lagoon.[5] Crops of sugarcane are the primary source of excess nutrients (mostly as dissolved inorganic nitrogen from fertiliser) and pesticides (particularly herbicides).[5]

The Great Barrier Reef is a valuable environmental, cultural and economic asset

The Great Barrier Reef is listed as a World Heritage Area. This comes with a responsibility to protect the Reef's values for current and future generations.

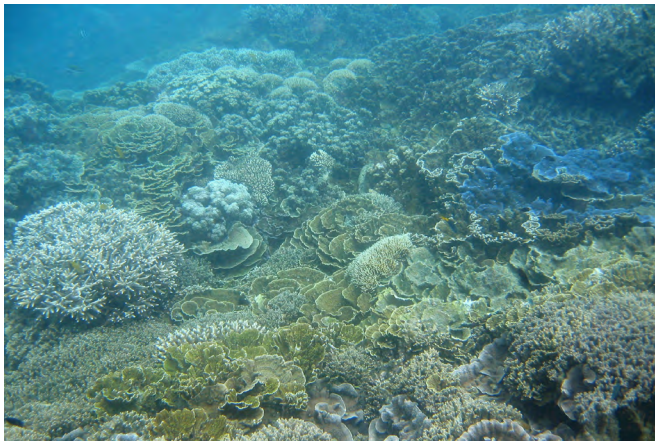
The Great Barrier Reef Marine Park Authority manages the Marine Park under the *Great Barrier Reef Marine Park Act 1975.*[49]

The Reef is worth an estimated $6.4 billion annually to the Australian economy[50] — a contribution largely derived from the tourism industry — with the Reef attracting around two million visitors each year from across the globe.[3]

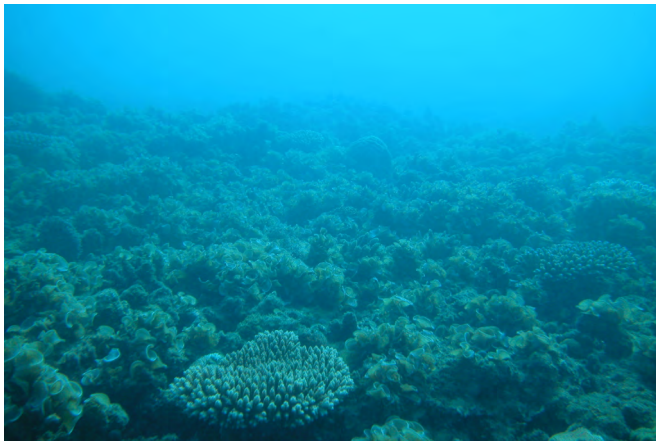
Traditional Owners have cultural connections with the Reef that extend back thousands of years.[3]

A range of pollutants from other agricultural industries (e.g. horticulture), urban areas, sewage treatment plants, mining, industrial areas, ports, and defence activities are also detected in the waters of the Marine Park.[3,6,16] Pollutants from these sources may be important at local scales and include coal dust, petroleum hydrocarbons, heavy metals, marine debris and microplastics, pharmaceuticals and personal care products.[6,15,16]

Despite considerable efforts to improve water quality, land-based run-off remains one of the most significant threats to the long-term health and resilience of the Reef.[1,3] Together with climate change and other cumulative pressures such as coastal development, poor water quality is contributing to the current poor state of many inshore marine ecosystems.[3,31,32]



Reefs in Princess Charlotte Bay, a relatively unpolluted environment. Photographer: K. Fabricius[26]



Reefs in the Wet Tropics region exposed to land-based run-off. Photographer: K. Fabricius[26]

GBRMPA Document No: 100516 Revision: 0
Date: 27-Oct-2020

Impact: land-based pollutants reduce Reef resilience

Rivers deliver loads of sediment, nutrients and pesticides to the Marine Park that can be well-above natural concentrations, particularly from highly modified catchments in the wet season.[4,6] The impacts of these pollutants on the Reef are well-documented. For example:

- High concentrations of fine sediment can reduce coral diversity, affect reproduction, disrupt coral recruitment and increase susceptibility to disease.[2,33] It can also damage gills and affect the metabolism of some fish species. [34]
- Suspended sediment, together with nutrients and other organic particles, reduces the amount of available light for seagrass and corals to grow. [2,9,35]
- High concentrations of nutrients are an additional stress factor for many coral species and can exacerbate outbreaks of crown-of-thorns starfish.[2,11,12,13] Nutrients can also promote excess growth of algae, which competes with coral for space, and epiphytic algae reduces the capacity of seagrass to photosynthesise.[8,10,31]
- Pesticides used on crops to protect against pests can harm coastal habitats and some estuarine and nearshore marine habitats.[2,14]

The relative risk of impacts to the Marine Park from land-based run-off varies between catchments, pollutants and the distance from the coast.[4,29]

Importantly, marine ecosystems have shown the capacity to recover partially from impacts during periods of reduced catchment run-off.[10,31] However, existing loads of pollutants in the system can continue affecting the Reef for many years.[9,36,37] Reducing pollutant loads improves the long-term outlook for the Reef.

In addition to land-based activities, ports, shipping, marine tourism and other uses of the Marine Park may have localised impacts on water quality through dredging activities, spoil disposal at sea, coal dust contamination, pollutant spills, antifouling paints, discharge of waste and resuspension of fine sediment by propeller activity.[3,5] Regulatory measures are in place to reduce the scale of impacts from these activities on the Marine Park. For example, threats associated with capital dredging and associated disposal of dredge material have decreased since implementation of the *Sustainable Ports Development Act 2015*[38] and amendments to the Marine Park Regulations[39] in 2015.

Chronic exposure to poor water quality reduces the capacity of the Reef to withstand and recover from the impacts of climate change.[2,3,31]

Understanding the combined risk of thermal stress and multiple pollutants is a developing field. For example, exposure to dissolved inorganic nitrogen may reduce the temperature threshold at which coral bleaching occurs[40,41,42] and thermal stress may increase the risk of contaminant impacts on tropical marine species.[43] This has important implications for water quality guidelines given the frequency of destructive marine heatwaves is predicted to further increase.[44] Management actions that improve water quality will mitigate some of the short-term impacts of climate change by supporting Reef resilience.[17,18,31]

Marine Monitoring Program

Progress towards Reef 2050 Water Quality Improvement Plan targets is assessed through an annual report card. Information on the condition and trend of inshore water quality, seagrass meadows and coral reefs comes from the Great Barrier Reef Marine Monitoring Program and eReefs modelling program. Understanding how the health and resilience of the Reef is affected by pressures is critical for evaluating the effectiveness of management actions. The Marine Monitoring Program also informs other initiatives, including regional report cards for the Mackay Whitsunday, Wet Tropics, Townsville and Fitzroy regions.

The program is a collaborative partnership funded and managed by the Authority, with co-funding from research partners. It is a foundational element of the Reef 2050 Integrated Monitoring and Reporting Program.

Crown-of-thorns starfish outbreaks

Crown-of-thorns starfish are predators of live coral and can rapidly reach 'outbreak' densities causing significant coral mortality across the Marine Park.[51] A combination of factors is likely to provide the conditions for an outbreak. This includes evidence of a link between outbreaks of crown-of-thorns starfish and poor water quality.[2,11] Increased loads of nutrients and greater frequency of flood events may exacerbate outbreaks, as nutrients enhance the capacity of starfish larvae to survive, multiply and spread. Improving water quality could help to reduce the frequency and intensity of outbreaks, however, many knowledge gaps remain.

Through the Blueprint for Resilience, the Great Barrier Reef Marine Park Authority works in partnership with multiple organisations to control densities of crown-of-thorns starfish to protect priority reefs. Targeted and repeated culling is essential to keep densities below thresholds so corals continue to grow.

AMPTO diver monitoring and eradicating crown-of-thorns starfish © Commonwealth of Australia (GBRMPA) photographer: Daniel Schultz

GBRMPA Document No: 100516 Revision: 0
Date: 27-Oct-2020

Actions and outcomes: partnerships to improve water quality

The Australian and Queensland governments are committed to improving the quality of water entering the Reef from land-based run-off through implementation of actions under the Reef 2050 Water Quality Improvement Plan.[20]

Water quality targets are based on the quality of water that corals and seagrasses need to be healthy[35,45], as defined by the Reef water quality guidelines. They define the reductions in pollutants required for each catchment to help protect the Marine Park. The targets inform investment in improved land management practices across community, industry and government sectors.

While there have been improvements in land management practices at the regional level, progress towards land and catchment management targets has been limited.[21,22] Effective collaboration and cooperation between government, industry, regional bodies and farmers is essential to achieving these targets. The Smartcane, grazing and other agricultural best management practice programs are examples of strong partnerships that improve productivity, profitability and sustainability of farm enterprises.[7] More needs to be done to expand and accelerate the adoption of best management practices across current and future land uses.[7,25,46] Industry-led projects by cane farmers such as trials of enhanced efficiency fertiliser technology in catchments of the Reef, together with additional mechanisms including regulatory tools, will help to progress beyond minimum practice standards and reduce harmful run-off to the Reef.[7]

Johnstone River flood plume © Commonwealth of Australia (GBRMPA)

Water Quality Guidelines for the Great Barrier Reef

The Authority developed water quality guidelines to support a healthy Reef ecosystem. They set limits for levels of sediments, nutrients and pesticides in marine waters.

The guidelines underpin water quality targets in the *Reef 2050 Water Quality Improvement Plan*[21] and are implemented as regional catchment-level objectives through Queensland's Environmental Protection (Water and Wetland Biodiversity) Policy 2019.[52] They inform planning and decision making for development under the Environmental Protection Act and State planning policy. Water quality objectives also apply to Reef waters that are outside state coastal waters.

A national review of water quality guidelines is underway and guideline levels have been updated for a number of pesticides. When the review process is complete, these will be adopted for the Great Barrier Reef.

The challenge of improving water quality in Reef catchments is big, but not insurmountable.[24,25,46] Achieving targets for water quality that support a healthy and resilient Reef ecosystem requires collaborative action commensurate with the scale of the challenge. Current initiatives provide a solid foundation for greater coordination and collaboration across all sectors to achieve the required reductions in pollutant loads. Improvements to land and catchment management practices can be achieved through tailored and innovative solutions that address social and economic factors.[7]

The health of the Reef and its catchment are closely linked, and there is a lag between delivering actions and realising their benefits in the Marine Park. [1,3] Building a more comprehensive picture of the effectiveness of land management programs to address water quality will strengthen existing and future efforts to reduce pollutants entering waterways. Complementary efforts to protect and restore key coastal ecosystems[25,46,47] will help to improve outcomes for Reef water quality. Actions taken now to achieve the Reef 2050 Water Quality Improvement Plan targets will make a difference to the long-term outlook of the Reef.

In summary

Pollutants in land-based run-off are a major threat to the Great Barrier Reef, particularly its coastal and inshore areas. While recognising the considerable efforts of agricultural and other land-based industries to improve water quality to date, there remains an urgent need to implement innovative and targeted actions to further improve the quality of water entering the Reef from all land-based sources. This must happen in parallel with other actions that also build Reef resilience.

This position statement is endorsed by the Great Barrier Reef Marine Park Authority Board. For the evidence underpinning this position statement, refer to the Great Barrier Reef Outlook Report 2019 and supporting references.

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